REMARKS

Claims 1, 3 – 10 and 12 – 26 are now pending in the application. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.

REJECTION UNDER 35 U.S.C. § 102

Claims 1, 3 – 10 and 12 – 26 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Lentz (U.S. Pat. No. 5,216,606). This rejection is respectfully traversed.

Claims 1, 10 and 20, as amended herein, include an apparatus and method of controlling cooling of a friction device, wherein a temperature state is estimated based on an estimated heat rate of the friction device and a cooling fluid flow is regulated based on the temperature state. Lentz fails to teach or suggest regulating cooling of a friction device based on an estimate temperature state, which is based on an estimated heat rate of the friction device.

The present invention provides friction device **cooling** control without using a friction device temperature sensor. There is a critical interface temperature, at which damage to the fluid and/or the friction device occurs. The cooling control of the present invention uses an estimated heat generation rate to estimate, as opposed to physically measure, a temperature state of the friction device. In this manner, the control system is simpler, faster-acting and more robust than traditional systems. The estimated temperature state is the leading indicator of required **coolant** flow to ensure that sufficient **coolant** flow is always present in time to remove friction heat, regardless of how fast the friction heat builds. Further, the model-based approach of the present

invention can comprehend the critical interface temperature limit directly, thereby eliminating guesswork and destructive trials-and-errors of a sensor-based system.

Lentz discloses a compensated control method for filling an on-coming clutch in an automatic transmission. A clutch fill time (T_{FILL}) is determined from a look-up table and is the time required to fill the clutch with hydraulic fluid to initiate engagement of the clutch (Col. 4, Lines 44 – 45). A pump is driven by the engine to provide pressurized hydraulic fluid to the torque converter clutch (TCC) and the clutches C1 – C5 (Col. 3, Lines 32 – 41). The pump efficiency is determined based on the temperature of the hydraulic fluid and the pump speed is adjusted based on the pump efficiency (Col. 6, Lines 1 – 18). In this manner, the pump is adjusted based on the fluid temperature to achieve T_{FILL}.

Lentz is not directed toward **cooling** a friction device, but instead is directed toward accounting for temperature changes in the hydraulic fluid used to **actuate** the friction device. In this manner, Lentz enables torque transfer through the friction device to be accurately regulated, regardless of the temperature of the hydraulic actuating fluid. Accordingly, the system of Lentz provides no improved heat protection for the friction device.

Further, Lentz is limited to actually measuring a fluid temperature to adjust a pump speed and fails to teach or suggest estimating a friction device temperature or estimating a heat rate of the friction device. Accordingly, each of claims 1, 10 and 20 define over the prior art and reconsideration and withdrawal of the rejections are respectfully requested.

Claims 3 – 9, 12 – 19 and 21 – 26 each ultimately depend from one of claims 1, 10 and 20, which define over the prior art, as discussed in detail above. Therefore, claims 3 – 9, 12 – 19 and 21 – 26 also define over the prior art for at least the reason stated with respect to claims 1, 10 and 20, and reconsideration and withdrawal of the rejections are respectfully requested.

In response to Applicant's previously filed argument, the Examiner has noted that Applicant's argument is unclear because claims 4, 13 and 22 claim a measured temperature using a temperature sensor (see Point 5, Page 8). As provided in claims 4, 13 and 22, a sump temperature of the cooling fluid is measured, as the temperature of the fluid entering the friction device affects the heat rate of the friction device. The sump temperature sensor is a temperature sensor that is normally provided and is therefore not an additional component. The present invention, however, enables estimation of a temperature state without an additional temperature sensor dedicated to the friction device.

Claims 1, 3 – 10 and 12 – 26 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Buchanan (U.S. Pat. No. 6,715,597). This rejection is respectfully traversed.

Claims 1, 10 and 20, as amended herein, include an apparatus and method of controlling cooling of a friction device, wherein a temperature state is estimated based on an estimated heat rate of the friction device and regulating a cooling fluid flow based thereon. Buchanan fails to teach or suggest regulating cooling of a friction device based on an estimate temperature state, which is based on an estimated heat rate of the friction device.

As discussed in detail in the response filed on October 12, 2005, Buchanan discloses a method of controlling clutches in a dual clutch transmission. The method includes providing a pre-determined cooling fluid flow to the clutch, measuring the temperature of the cooling fluid leaving the clutch, determining a total bulk clutch temperature change and changing the cooling fluid flow based on the total bulk clutch temperature change (Col. 11, Lines 29 – 43). The total bulk clutch temperature change is determined from an initial bulk clutch temperature change and a secondary bulk clutch temperature change (Col. 12, Lines 25 – 47). The initial bulk clutch temperature change is based on a power transfer across the clutch and the secondary bulk clutch temperature change is based on the measured fluid temperature (Col. 11, Line 66 – Col. 12, Line 24).

Accordingly, Buchanan discloses a reactionary system that determines bulk clutch temperature change based on a measured fluid temperature. As a result, Buchanan does not account for the delay between heat generation and temperature measurement, which can result in clutch and/or fluid damage before adequate fluid flow is provided. More specifically, within the time between the fluid leaving the clutch and measuring the fluid temperature, the clutch temperature can significantly increase and clutch damage can occur.

In view of the foregoing, Buchanan fails to teach or suggest estimating a clutch temperature based on an estimated heat rate. Accordingly, claims 1, 10 and 20 define over Buchanan and reconsideration and withdrawal of the rejections are respectfully requested.

Claims 3 – 9, 12 – 19 and 21 – 26 each ultimately depend from one of claims 1, 10 and 20, which define over the prior art, as discussed in detail above. Therefore, claims 3 – 9, 12 – 19 and 21 – 26 also define over the prior art for at least the reason stated with respect to claims 1, 10 and 20, and reconsideration and withdrawal of the rejections are respectfully requested.

In response to Applicant's previously filed argument, the Examiner again notes that Applicant's argument is unclear because claims 4, 13 and 22 claim a measured temperature using a temperature sensor (see continuation of Point 5, Page 9). As provided in claims 4, 13 and 22, a sump temperature of the cooling fluid is measured, as the temperature of the fluid entering the friction device affects the heat rate of the friction device. The sump temperature sensor is a temperature sensor that is normally provided and is therefore not an additional component. The present invention, however, enables estimation of a temperature state without an additional temperature sensor dedicated to the friction device.

Buchanan, on the other hand, requires two temperature sensors, one to monitor the sump temperature and another to monitor the temperature of the fluid exiting the friction device (see 242 of Figure 3A). Accordingly, Buchanan provides an excellent example of an overly complicated and more expensive system, which the present invention simplifies.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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